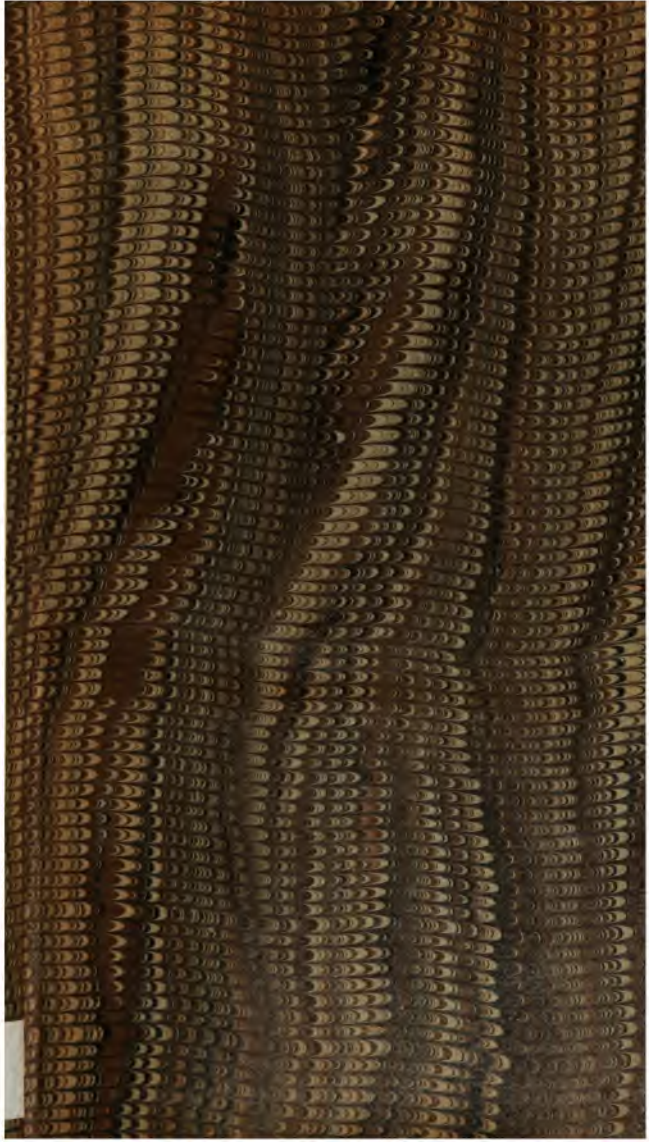

AMERICAN AND ENGLISH

Reports, References and Certificates

CONCERNING THE

PATENT BOX

LINED WITH SOFT METAL,

INVENTED BY

ISAAC BABBITT.

PRINTED FOR THE PATENTEE.

BOSTON:
OAKES & SOLOMONS,
Stationers, 20 State Street.
1848.

REFERENCES, CERTIFICATES, &c.

ISAAC BABBITT, of Boston, Mass., having obtained Letters Patent of the United States for a Lined Box, suitable for all revolving and sliding motions in the various kinds of machinery, where great weight or speed are applied, would respectfully invite the attention of all persons interested in machinery to the following Certificates, References and Reports concerning it. He would refer, in the first place, to the following Railroad, Steamboat and Manufacturing Companies — by whom its use has been extensively adopted — as to the *value* of the improvement, viz.:

RAILROADS.

Eastern; Boston and Worcester; Boston and Providence; Boston and Lowell; Lowell and Nashua; Nashua and Concord; Taunton Branch; Taunton and New Bedford; Norwich and Worcester; Western; Portland, Saco and Portsmouth; Old Colony; Concord; Boston and Fitchburg; Boston and Fall River; Boston and Maine; Providence and Worcester; Champlain and Connecticut River; Springfield, Hartford and New Haven; Vermont Central; Northern, N. H.; Northern, N. Y.; Troy and Schenectady; New York and Erie; Attica and Buffalo; Buffalo and Niagara; Jersey City and New Brunswick; Philadelphia, Wilmington and Baltimore; Baltimore and Susquehanna; and Philadelphia and Reading.

STEAMBOATS.

The New Jersey Steam Navigation Company, — and the following, among others: the Worcester, New York, Charter Oak, Bangor, Huntress, Bay State, and Empire State.

MANUFACTURING COMPANIES.

Amoskeag, Manchester, N. H.; Lowell Machine Shop; Essex, Lawrence, Mass.; Boston Iron; Tremont Iron, Wareham; Massasoit Steam Mill, Fall River; Fall River Iron; American Print Works; Anawan; Fall River; Troy; Robson & Sons Print Works; Pocassett; Fall River, Mass.; Lewiston Manufacturing Company, Me.; Fairbanks, Bancroft & Co., Providence, R. I.; Boston Manufacturing Co., Waltham, Mass.; Allaire Works, New York City; Buffalo Steam Engine Works, Buffalo, N. Y.; Phœnix Foundry, New York City; Secor & Co., New York City; Joseph Hall, Rochester, N. Y.; J. Norton Poole, Rockford, near Wilmington, Del.; Merrick & Towne, Philadelphia, Penn.; Andrew Fulton, Pittsburg, Penn.; E. T. Taylor & Co., Columbus, Ga.; and Leeds & Company, New Orleans, La.

It is also used on board all the Steam Frigates, and in all the Public Works of the United States.

CERTIFICATES.

We, the undersigned, being practical mechanics, and having used Mr. Isaac Babbitt's PATENT IMPROVED LINED BOXES, for a sufficient length of time to test fully the merits of the improvement, hereby certify, that we know of no kind of Box so durable, nor any which operates so smoothly and with so little wear when applied to any kind of revolving or sliding motion in machinery, where great weight and speed are applied.

In the use of these Boxes, friction is reduced in a remarkable degree. Oil is required only in small quantities, and the wear is hardly perceptible during a period in which a

hard metal box of the same thickness would be worn out. Journals running in these boxes, attain a smoother surface than we have seen on those which have been run in any other Box.

We can also certify that the Patentee of this improvement has received the highest award of the Massachusetts Charitable Mechanic Association, for specimens of these Boxes, (some of which had been run on the crank of a locomotive engine more than 30,000 miles,) at the Fair of the Institution held in Boston, in September and October, 1841.

HINKLEY & DRURY — Locomotive and Stationary Engine Builders, Boston, Mass.

BUSH & LOBDELL — Founders, Machinists and Engineers, Wilmington, Del.

JAMES MILLHOLLAND — Superintendent of Motive Power, Baltimore and Susquehanna Railroad, Baltimore, Md.

OTIS TUFTS — Engine Builder, Boston, Mass.

SETH WILMARTH — Machinist, Boston, Mass.

GEORGE S. GRIGGS — Superintendent Motive Power, Boston & Providence Railroad, Boston, Mass.

The Committee of the Franklin Institute of Philadelphia, which was appointed for the purpose of awarding the premiums of the Scott Legacy, which are only awarded for such improvements as are proved to be new and useful, have awarded the premium to ISAAC BABBITT, for the above-named improvement in Boxes, &c.

REPORTS.

IN SENATE OF THE UNITED STATES.

Mr. Choate made the following report, which was ordered to be printed April 28, 1842.

The Committee on Naval Affairs, to whom was referred a bill authorizing the Secretary of the Navy to purchase for the United States, the right to use Babbitt's anti-attrition metal, present the following report:

The facts upon which the Committee have decided to recommend the passage of the bill are these: Babbitt has letters patent for a mode of applying an anti-attrition metal to exposed parts of machinery, and confining the same thereto. The improvement thus patented, consists in the substitution of a soft unctuous metal, for the hard brass or composition heretofore used, to sustain the journals and other moving parts of machines, which soft metal is enclosed in a new and improved manner, in ribs or ledges of harder metal, to prevent its being spread by the weight of the shafting, or by pressure.

In the judgment of the Committee, the improvement is one which the Government ought to possess the right to use. It secures a great dimunition of friction, and a consequent saving of fuel, and saves one half or more than one half of the oil heretofore necessary; lessens the cost of the original construction of the brasses which receive the journals — since they may be made much lighter than before; lessens the expense of repairs, because the soft metal wears longer than the hard, and the ribs and ledges may be relined at small cost; communicates increased efficiency to the engines by the dimunition of friction; and prevents the heating of the journals, crank-pins, and other moving parts of the machinery.

The invention has been tested by a satisfactory series of experiments in different places, on different kinds of machinery, and by different persons of skill and judgment, and seems to be universally regarded, so far as it is known, as an improvement of great practical utility. The Committee refer to and make part of their report, the letters of S. V. Merrick, of 15th April, 1842; of J. Erricsson, of the 2d

April, 1842; of George C. Read, of 14th April, 1842, to the Secretary of the Navy; of Charles W. Copeland, of the 5th April, 1842, to Com. L. Warrington; of the Secretary of the Navy, of 12th April, 1842, to Hon. R. Williams; and of Charles Howard, of the 15th April, 1842, to Hon. R. Williams. The Franklin Institute, and other societies for the promotion of practical science, concur in the opinions expressed in those letters; and some one of them or more, has bestowed a gold medal upon the inventor.

The Committee are, therefore, of opinion, that the Secretary of the Navy, as a measure of true economy, should be authorized to purchase the right to use this improvement, and accordingly report the bill which was committed to them.

Washington, April 15, 1842.

SIR: Referring to a conversation with you this morning upon the merits of Babbitt's anti-attrition metal, I beg leave to submit, that Mr. Babbitt's invention consists of substituting a soft unctuous metal, for the hard brass or composition heretofore used to sustain the journals and other moving parts of machinery; which soft metal is enclosed in ribs or ledges of harder metal, to prevent its being spread by the weight of the shafting or pressure.

This metal has been long enough in use fully to test its merits, and I have no hesitation in saying, that it is one of the most valuable improvements, in the construction of moving machinery, that has come to my notice.

The effects produced are,

1st. A great diminution of friction.

2d. A saving of oil to the extent of one half or more.

3d. An economy in the original construction, as the brasses which receive the journals may be made much lighter when lined, than when they come in direct contact with the hard metal.

4th. A saving in repairs, as the soft metal will wear longer than the hard, and they may be relined at small cost.

5th. A saving of fuel consequent upon a reduction of friction.

My opinion is, that the introduction of this metal into the government steamers will be of essential service.

I herewith transmit a copy of a letter from Capt. J. Erricsson, the engineer employed by Captain Stockton to superintend the machinery of the "Princeton," United States war-steamer, which gives his view of the subject. Long experience in the use and construction of machinery, entitles his opinion to great weight.

I am, with much respect,

(SIGNED) S. V. MERRICK.

Hon. ABEL P. UPSHUR,
Secretary of the Navy.

New York, April 2, 1842.

DEAR SIRS: Your letter of 31st March, has come to hand, and I regret to learn that there are any difficulties in the way of employing Mr. Babbitt's anti-attrition metal in the engine now constructing for the "Princeton." In fact we have proceeded so far that we cannot now dispense with it.

Respecting the general utility of Mr. Babbitt's metal, I can safely assert, that there is not, in a strictly practical point of view, a greater desideratum in mechanics, and the advantages which will be derived from its employment in marine steam machinery, are of paramount importance. The complete prevention of the heating of the main journals and crank-pins, effected by the interposition of the anti-attrition metal, is an advantage in itself sufficient to warrant its employment. I once happened to be on board a steamer when, close on a lee shore, the crank-pin got so hot, that the engine had to be stopped, at the imminent risk of touching ground.

Again, in a dollar and cent point of view, the anti-attrition metal recommends itself strongly, as it will obviate the necessity of renewing the bearing brasses, the cost of supplying a new coating or lining of the soft metal being very trifling. Another important saving will be effected by the greatly diminished consumption of oil, consequent upon its employment.

To these advantages may be added an increased duty of the engines, owing to diminished friction; some saving of fuel must result from this. Again, and lastly, the important fact must not be lost sight of, that an engine, in which every bearing is provided with the anti-attrition metal, requires very little attention from the engineer, while its performance will be uniformly effective.

Yours truly, (SIGNED) J. ERRICSSON.

MESSRS. MERRICK AND TOWNE.

Commandant's Office, U. S. Navy Yard,
Philadelphia, April 14, 1842.

SIR: I have the honor to acknowledge the receipt of your letter of the 12th inst., and being desired to make an early reply, I hasten to give you all the information I have been able to obtain in the course of the day, respecting Babbitt's anti-attrition metal. Mr. J. Henry Towne, who knows as much upon this subject as any other person in this city, and who, I believe, was on the committee appointed by the Franklin Institute, gives the following information in answer to the queries contained in your letter.

"*Utility.*—Experience has proved the utility of Mr. Babbitt's application of anti-attrition metal. It has been used with great success on locomotives and steam-boat engines, in parts which are exposed to great stress, and where the ordinary composition is very rapidly abraded. Its advantages are found to be, 1st, increased durability; 2d, dimin-

ished friction; and 3d, reduced consumption of oil; to which might be added, the ease and cheapness of renewing a bearing when worn out.

"A Committee of the Franklin Institute in this city, after a careful examination of the merits of this invention, made a highly favorable report, and it is thought by those conversant with such matters, to be an improvement in machinery, of great practical utility.

"*Cost.*—The materials of which the anti-attrition metal is made, are not more costly than the materials in common use for the same purpose. Mr. Babbitt's agents sell it at the same price as the ordinary composition, and it is fair to infer that they have a handsome profit.

"*Amount required.*—This cannot be well estimated. It would be of comparatively small amount. Mr. Babbitt's patent is for the *method of confining* the metal, and with the privilege to use the patent, it would not be necessary to provide a stock in advance, because the materials could at any time be purchased, and the mixture made when required for use.

"*Value of the right to the United States*—would depend upon the extent of its application; but we cannot form a definite opinion on this point."

If further information should be required, Mr. Merrick and Mr. Copeland are now in Washington, and can furnish all that is desired.

I have the honor to be, sir, very respectfully, your obedient servant, (SIGNED) GEORGE C. REED.

HON. A. P. UPSHUR,

Secretary of the Navy, Washington, D. C.

Washington, April 5, 1842.

SIR: A new metal for the boxes of journals has been recently introduced, known as Babbitt's patent metal. The patentee, Mr. Babbit, is now in Washington.

I would respectfully suggest that some arrangement be made with him for the use of his metal on board the steamers about being built. The metal has been thoroughly tested in the navy yards at Washington and Boston, and also on board the steamer Fulton.

I remain, sir, very respectfully, &c.,

(SIGNED) CHARLES W. COPELAND,

Steam Engineer, U. S. N.

COM. L. WARRINGTON,

President of the Board of Navy Commissioners.

Naval Department, April 12, 1842.

SIR: In reply to your letter of this morning, I have the honor to state that I have the most satisfactory testimonials in favor of Babbitt's anti-attrition metal. I am not however prepared to say what appropriation will probably be necessary. I will immediately write to Philadelphia, where the metal has been used, for full information upon the subject, which I will communicate to you, as soon as I receive it.

I am, respectfully, your obedient servant,

(SIGNED) A. P. UPSHER.

HON. R. WILLIAMS, *Senate.*

Office Baltimore and Susquehanna Railroad Co.
Baltimore, April 15, 1842.

SIR: At the request of Mr. I. Babbitt, of Boston, I take the liberty of giving you a statement in reference to his invention of a method of so constructing the bearings of steam and other machinery, as to interpose a soft metallic substance between the iron and brass which have heretofore generally been placed in contact with each other. Although I do not flatter myself that my opinion will be considered as

entitled to any weight, yet, having been requested to make it known to you, I feel bound to do so, because I am satisfied that in the machinery which the government may have occasion for, and especially in that which is to be applied to war-steamers, it is of high national importance that such machinery should be as perfect as possible; and because I am convinced that if Mr. Babbitt's invention is not made use of, a steam-engine cannot be made to operate with anything like the same efficiency that it would possess if constructed with his improvement.

After making, for some time, trials of his invention, which proved entirely satisfactory, I purchased of Mr. Babbitt last winter, for the sum of $1,050, the right to use it on the machinery of the Baltimore and Susquehanna Railroad Company, including their locomotives and cars which run between Baltimore and Wrightsville, Pennsylvania, a distance of 70 miles. The price was considered a high one, for the comparatively limited extent to which the Company would have an opportunity of making use of the patent right, but we were satisfied that it was for our interest to avail ourselves of the invention. I can now say, that, having better tested its value, by a more extensive application of it, I think that the Company would be very unwise to relinquish their right to use it, for a much higher consideration than that which was given for it; and I have no doubt, that if such a proposition were to be made to the Company, it would, without hesitation be declined.

The great merits of the invention are, that it prevents the heating and consequent cutting and destruction of the *bearings*, which are so numerous in a steam-engine, and on the perfection of which depends the value of the engine; while, at the same time, there is a very great saving of oil, the expenditure of which forms a material item in the cost of working a large engine. In the locomotives of the Company, I find the saving to be fully one-half of the quantity

which was required before Mr. Babbitt's invention was applied to them. Some of these locomotives having run several thousand miles, I can also say that this invention makes the machinery much more durable, so that while the effective power of the machine is increased, the cost of repairs is diminished.

It may be proper to add that I neither have now, nor have I had at any time, any interest in, or any connection with, Mr. Babbitt's patent right; or any acquaintance with him, other than that which has grown out of my having purchased from him, as I have stated, the right to use his invention. My only motives for addressing you are, a conviction of the importance to the public of an adoption of his plan by the General Government, and a desire that the inventor of a truly useful improvement shall receive that reward for his ingenuity which I think he richly deserves. The first of these reasons you will, I hope, sir, consider as a sufficient apology for my troubling you with this commmunication.

I have the honor to be, respectfully, your obedient servant,

(SIGNED) CHARLES HOWARD,

President Balt. and Sus. Railroad Co.

HON. R. WILLIAMS,

Committee Naval Affairs, Senate, U. S.

IN SENATE OF THE UNITED STATES.

An Act authorizing the Secretary of the Navy to contract for the purchase for the United States of the right to use Babbitt's anti-attrition metal.

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, That the Secretary of the Navy be, and he hereby is, authorized to contract for the purchase from the proprietor of the patented interest therein, for the United States, the right to use Babbitt's anti-attrition

metal in the construction of machinery, and other work; subject to the ratification of Congress.

Passed the Senate, July 19, 1842.

Passed the House, August 27, 1842.

Sale made in conformity to the above act, September 20, 1842.

CERTIFICATE.

Babbitt's anti-attrition metal* has been universally applied by this Bureau to the brasses of journals since the year 1842, and its application is deemed of such essential importance, that in all contracts and directions for the construction of engines and machinery, the use of it is made compulsory on the part of the contractor.

(SIGNED) CHARLES H. HASWELL.

Bureau of Construction, Equipment and Repair, Office of Engineer in Chief, U. S. N., April 9th, 1847.

Washington, April 10th, 1847.

ISAAC BABBITT, ESQ.:—

DEAR SIR: In compliance with your request, I take great pleasure in stating the result of my experience in the use of your anti-attrition boxes.

In the engines of all the government steamers which I have constructed, or had any connection with, the benefits which we were led to expect by your representations were fully realized, and, indeed, in some places, they would now be considered almost indispensable, from the great advantages experienced by their use.

I may mention that I have known some instances, where, notwithstanding every known means of prevention was resorted to, the journals would still heat and cut, and the

* Isaac Babbitt would inform the public that his Patent does not consist in the *use* of soft metal, simply, but *in the mode of its application and confinement* in boxes prepared for the purpose.

difficulty was finally only overcome by resorting to your patent boxes.

I am well acquainted with their use in the merchant service, and know that generally a marine engine is now considered incomplete without these boxes for all the important journals.

The advantages invariably experienced are, a saving of oil and labor, with economy in the expense of repairs.

With the hope that you may be able to extend the use of your invention with its benefits still more widely,

I remain, very respectfully,

(SIGNED) CHARLES W. COPELAND,
Naval Engineer.

ENGLISH REPORTS.

Liverpool and Manchester Railway,
Edge Hill Station, November 15th, 1843.

DEAR SIR: The "Ostrich Engine" fitted up with Babbitt's patent axleboxes and bearings, has now undergone a six weeks' trial with very satisfactory results. The period of work has been from September 29th to November 10th, during which the engine has run 156 trips of 30 miles, with passenger trains, — 4680 miles. The total oil supplied to the engine during this period has been 58 pints, which consumption averages only 1 1-2 pints per day, (120 miles) instead of 6 pints, the quantity required by all our other engines with the ordinary brass axleboxes. The saving of oil has therefore been 75 per cent. The axleboxes and bearings have been taken to pieces for inspection, and are in beautiful order. The journals have a high polish upon them, superior to that of journals which run on brass sur-

faces. The only repairs done since the engine went to work has been the letting together of the brasses of one of the connecting-rod-ends, the 1-32 part of an inch. This connecting-rod-end was rather slack to begin with. No repairs are wanted, and we shall put the parts together again just as they were before. None of the bearings have offered to heat.

I am of opinion that it is highly desirable to apply the principle to other of the Company's engines, and shall be glad to have the decision of the Board upon the subject. The oil for our locomotive engines costs at present about £600 a year. The saving in this article is of course a matter of importance, but less so, in my opinion, than the saving of wages in repairs of brasses and fitting.

I am, dear sir, yours truly,

(Signed) EDWARD WOODS.

Henry Booth, Esq.

REPORTS

ON

BABBITT'S PATENT

LINED BEARINGS OF MACHINERY.

BY

MESSRS. FAREY, GLYNN, CUBITT, HICK, &c.

JOSEPH WOODS AND CO.,
AGENTS FOR THE PATENT,
3, BARGE-YARD CHAMBERS,
BUCKLERSBURY, LONDON.

REPORTS ON BABBITT'S PATENT.

Her Majesty's Sloop Rattler,
Oporto, June 20, 1846.

My dear Sir,—I enclose you a copy of a report from my chief engineer, and also send you my opinion in a few words; the sooner it becomes universally known to the maritime world, and universally used, the better it will be for the engine-maker, and less cost to the proprietor. I cannot speak too highly of it; and every day the consumption of tallow decreases, as the journals become smooth. I have written to Mr. Corry, telling him I have informed you of my opinion, as well as sending you a copy of Mr. Langland's report; but you are to print nothing without his permission. The pitch line of wheels are as they were set when you were on board. Wishing you success,

Believe me, truly yours,

H. SMITH.

Mr. J. Woods.

P. S.—We were seventy-one hours steaming from Cork to Oporto, sometimes going eleven, never less than eight knots; every thing perfectly cool: the grease on bearings and caps keeping perfectly firm, like tallow in a shop, and feeding as bearings required.

Oporto, June, 1846.

Sir,—In compliance with your order, I beg to report that the application of soft metal to the bearings of Her Majesty's steam-sloop *Rattler* has been highly satisfactory. The bearings of propelling-shafting, from the long use of water, had been in a corroded state; and owing to the unequal distribution of the pinion-bearings, the foremost being nearly six feet from pinion, and after one four inches, a great pressure is sustained by the after pinion-bearing. On the trial, May 7, 1846, it heated considerably, that was partly owing to the journal not resting its whole length on the bearings, it has gradually come to a bearing, and no heating has occurred in that or any other bearing lined with soft metal. Tallow has been found preferable to oil; the caps are withdrawn, hollow caps fitted, which are filled with tallow; the expenditure of tallow for the three foremost bearings is twenty pounds per day, of that one-half is consumed by the bearing next to and after the pinion. Previous to lining the connecting rod-brasses, the foremost continually heated, when the engines were put in motion; since the application of soft metal no heating takes place, with the exception of the first trial, when they slightly heated, but the application of tallow soon reduced their temperatures, and their expenditure is now one pound of tallow for twenty-four hours; after six days' steaming, the connecting-rods have not required tightening. The application of soft metal to receive the thrust of propelling-shaft was not so successful, a steel-pin was lined and prepared to receive the convex end of the steel-pin fitted in propelling-shaft, the engines were not long in motion when the soft metal was scoped out and thrown aside, the oil cup was afterwards found to be empty, the ends of the pin brassed, others were substituted, working in water; to prevent the water coming in contact with the foremost bearing, a lead tank is filled, which I find answers the purpose. The application of soft metal, if I may be allowed to express an opin-

ion, I consider as a valuable introduction in steam-machinery, especially in screw-steamers, when high velocities are required; and as considerable wear and expenditure is incurred in the V guides, I beg to suggest that, at a fitting opportunity, the lining be applied to the V guides also. The expenditure for lubrication is gradually reducing, and, as the bearings arrive at proper surfaces, will be trifling compared with the former wear and tear.

A. LANGLANDS,
First Engineer of Her Majesty's Sloop Rattler.

To Commander SMITH, R. N.

Her Majesty's Steam Sloop Rattler,
Portsmouth, January 30, 1847.

SIR,—I respectfully call your attention to the working of the bearings on board of Her Majesty's sloop *Rattler*, which have been lined with soft-metal, and which, since her proceeding to sea, May 11, 1846, have never given us the slightest trouble, although previous to adopting this improvement, we were constantly compelled to keep streams of cold water pouring upon the bearings of propelling-shaft, and frequently on the connecting-rods, and three sets of brasses were worn out on propelling shaft in sixteen months, whereas we have now had nine months' experience, and the bearings on examination appear to be in as perfect condition as when first put to work; they have never heated, and the consumption of oil and tallow has been diminished to about one-fifth of the quantity formerly consumed; no wear appears to have taken place, and the connecting-rod bearings, which formerly gave us much trouble, have never been tightened during that period. I have measured the consumption of tallow in the connecting-rod bearings on our last trip from Lisbon to Plymouth. I placed one pound of tallow in the grease-cup of each engine, and on arrival at Plymouth found

one-fourth remaining; and during six days four hours the engines were constantly at work. The brass bearings continue to consume large quantities of tallow and oil in consequence of their tendency to heat. I would suggest that the remaining bearings be lined and lubricated by cylinders of tallow pressed by a spring, as I feel confident that four-fifths of the tallow would be saved; that the engines would be kept in a constant state of cleanliness; and the efficiency of the machinery insured to a highly important extent.

I am your obedient servant,

A. LANGLANDS,

First Engineer, Rattler.

To Commander MOORMAN.

Soho Iron Works, Bolton,
August 14, 1847.

SIR,—I am sorry to inform you that Mr. Hick is seriously indisposed, and consequently unable to attend personally to the subject of your note of the 10th instant, but has instructed me to hand you the following particulars, referring to a few cases where we have used Babbitt's Patent Bearings with great advantage. We have used them under a variety of circumstances, some of which we consider to have been severe tests of their efficiency; and the result in all cases has been, a greater durability and a diminution of friction; I therefore think it unnecessary to particularise more than the following instances:—

The Park Mill Company, cotton-spinners of this town, were at considerable trouble and expense in consequence of their main-shaft working very hot, and wearing away very rapidly the different brass bearings we from time to time put under it; the shaft-bearing was also injured by being grooved and made rough with friction. In July, 1846, we recom-

mended them to have a new brass bearing lined with Babbitt's soft metal, to which they consented, being anxious to obviate the annoyance and risk of fire; since its application it has worked very cold, and not shown the slightest indication of wearing away.

Messrs. Hargreaves and Brothers, also of this town, have got a pair of short-stroke fifty-horse engines, they are connected together marine-wise, *i. e.*, the power of one engine passes through the crank of the other to the main driving-wheel on one side of the engine-house, and there is a heavy fly-wheel between the engines. The bearings on the crank-shafts were very troublesome, in consequence of their heating and rapid wear, until we had them lined with Babbitt's soft metal, which has entirely remedied the annoyance.

I could multiply instances, but think it needless, as the result has always been the same, and I doubt not that Babbitt's soft metal will become more extensively used than it now is when it is better known.

Should you wish further particulars, we shall be glad to give them.

Yours, &c.,
For Benjamin Hick and Son,
GEORGE BELL.

To Joseph Woods, Esq.

Bolton Bleach Works,
15th of September, 1847.

Gentlemen,—In reply to your inquiries respecting the working of Mr. Babbitt's lined bearings, as applied to our calendars since June, 1844, we have much pleasure in giving you our testimony as to their efficiency; they have in each instance succeeded perfectly in diminishing the tendency to heat and the consumption of oil; their application

to our calendars is a very severe test, since they have to bear a pressure of twenty tons each on two bearings, four and a half inches diameter and five inches long. The journal makes forty revolutions per minute, and although lubricated by oil they are always perfectly cool, whereas the bearings in ordinary use, made of brass, were constantly heating, and we had much difficulty in keeping them in order.

We have now had Mr. Babbitt's lined bearings in use for three years, and find but little perceptible wear in them; no accident is likely to occur to them, unless they are left without oil, a circumstance which once occurred to us; however, no injury resulted from the film of soft metal melting out, as the brass immediately sustained the weight.

Your most obedient servants,

RIDGWAY, BRIDSON, SON, & CO.

To Joseph Woods & Co.

3 *Barge-Yard Chambers,*
Bucklersbury, London.

P. S. We may observe that we are now subjecting these improved bearings to still greater tests, and we are inclined to believe that the results will be perfectly satisfactory.

The Report of John Farey, Esq., *and* Joseph Glynn, *F. R. S., M. Instr., C. E., &c., on the Patent Soft Metal Bearings invented by Mr. Babbitt, as applied to certain parts of the Engines and Machinery on board of Her Majesty's Steam Ships "Victoria and Albert," "Fairy," and "Rattler."*

London, October 9, 1847.

Sir,—Having examined the steam-engines on board of Her Majesty's yachts *Victoria* and *Albert*, and *Fairy*, now lying at Portsmouth, and also the engines of Her Majesty's

steam sloop *Rattler*, now at Woolwich, with a view to ascertain the results of the application of the Patent soft Metal Bearings invented by Mr. Isaac Babbitt, of Boston, in the United States of America, to certain working parts of the engines and propelling machinery of those vessels, we have to report as follows:—

The engines of the *Victoria* and *Albert*, are a pair of the collective power of 400 horses, constructed by Messrs. Maudslay, Field, and Co., on their well-known patent plan of direct acting double-cylinder engines actuating paddle-wheels. The crank-pins of these engines are twelve inches and three-quarters in diameter, and the length of their bearing twelve inches and a quarter. They were originally fitted with blocks of gun-metal of good quality, and the workmanship also was accurate and good.

The great force applied to the crank-pins and the quantity of motion incident to the bearing parts of them, produced considerable abrasion of the metal in these bearings, causing much friction, which the utmost application of oil and tallow failed to obviate, and evolving great heat, which could not be prevented even by constant quenching with water.

Every expedient which the practical knowledge and skill of the experienced engineer in charge of the vessel's machinery could devise, appears to have been tried without effecting a remedy, and the surfaces of the crank-pins even now show the great abrasion and wear which had been going on before the application of the Patent soft Metal Bearings.

The use of Mr. Babbitt's simple but ingenious invention has completely obviated an inconvenience, serious at all times on board of a steam-ship, but especially so in this instance, whilst the improvement has also been attended with a great saving in cost and attention to the lubrication of the bearings.

The successful application of the Patent soft Metal Bearings is peculiarly remarkable in this case, for it appears, that

before its introduction the vessel could not proceed to sea without the crank-pins speedily becoming so much heated by friction as to render it almost imperative to stop the engines, when such stoppage was incompatable with the nature of the service; whereas, since the use of the soft metal, Her Majesty's recent voyage to Scotland and back has been performed without any inconvenience arising from heat or abrasion in these bearings, and with a very considerable reduction in the quantity of oil and tallow expended.

This case is also highly satisfactory, because the length of the soft metal which now actually bears against the crank-pin is only equal to eight inches, which is less than two-thirds of the length of the former gun-metal bearings; yet, notwithstanding the less extent of surface, no abrasion has taken place, nor is there any appreciable diminution of the substance of the soft metal, the more prominent parts alone as yet being in contact.

The particles of gun-metal still embedded in the surfaces of the crank-pins, evince the great abrasion of the former bearings, whilst the polished, silver-like surface of the soft metal shows the severity of the friction has been removed.

The engines on board of her Majesty's yacht *Fairy*, are a pair of direct acting vibrating engines, constructed by Messrs. Penn and Co., of the collective power of 120 horses, making about 200 revolutions per minute.

The patent bearings have been applied to the crank-shaft of these engines, and the results have been similar to those on board of the *Victoria* and *Albert*, and equally successful. But the most remarkable application of this patent invention on board of the *Fairy*, is in the disc or step, which receives the end-thrust of the revolving propeller shaft. It is obvious that all the force that is exerted to propel the vessel must be transmitted by the end of the revolving shaft to the surface of this disc or plate.

The soft metal in the face of the disc is disposed in four quadrant-shaped surfaces, the metal being lodged and retained within corresponding cells, being formed by a circular border-rim, with two fillets of the gun-metal crossing each other at right angles at the centre of the disc, in which fillets is a cruciform channel for the introduction of water or of lubricating fluids, and near to the centre of the step a portion of the intersecting gun-metal fillets forms the surface with which the central part at the end of the shaft comes in contact.

It is requisite to mention these points in detail, because the only abrasion which has taken place appears at the central part of the end of the shaft, and the gun-metal surface opposed to it, where the quantity of motion is least, the soft metal in the four quadrants showing a bright surface without abrasion, and but slightly reduced in substance, and indicating a degree of resistance likely with ordinary care to last some time.

This end-bearing is one of the greatest importance in a steam-ship propelled by a screw. The propelling force of the screw, which in this vessel gives it a high speed, is wholly received and resisted upon a surface of about five inches and a half in diameter.

It appears that in the first instance a pivot of hardened steel was used at the end of the revolving shaft, acting against a step of the same material, but they could not be kept long in a working state from the great heat occasionally evolved, and eventually the friction and heat became so intense as to destroy the surfaces in contact and cause their cohesion, but since the introduction of the Patent Bearings the surfaces in contact can be kept in good working order without difficulty.

Her Majesty's steam-sloop *Rattler* has a pair of engines with four cylinders, constructed by Messrs. Maudslay, Field, and Co., on their patent plan of collective power of 200 horses,

and the vessel is propelled by a screw-propeller upon a second shaft, making about 100 revolutions per minute.

The engines make about twenty-five revolutions per minute, and drive the propeller by means of a toothed-wheel and pinion. The crank-shaft of the engines is directly above the shaft of the propeller, and, consequently, the bearing immediately adjacent to the pinion has to sustain considerable stress from the drift of the geering of the wheel-work as well as the weight of the pinion, in addition to what it is subjected to in common with the other bearings of the propelling-shaft in transmitting the power of the engines, and this unequal stress is further increased in consequence of the other bearing for the end of this shaft being placed forward nearly six feet from the pinion.

The connecting-rods of these engines were originally fitted with gun-metal bearings on the crank-pins. These bearings are eight inches in diameter, by eight inches long, and were also liable to heat from the friction and abrasion of the gun-metal; but these bearings having since been fitted with soft metal, no inconvenience is now found to arise from heating, the warmth excited has not been more than sufficient to melt the tallow placed in the cups, and the consumption of the lubricating material has been much reduced since the application of the soft Metal Bearings.

We were informed that they had been in place about a year and three-quarters, during which period the vessel has been employed in towing, and various services, yet the soft metal does not appear to have worn so much as to bring the whole of its surfaces in contact with the crank-pins; it is, therefore, as good as when first applied.

Patent bearings were likewise applied to the shaft of the screw-propeller, since which the *Rattler* has made a voyage to Buenos Ayres, and has been otherwise employed in South America and elsewhere; these bearings appear in excellent

order, including the one close to the pinion, which, as already mentioned, is exposed to so great a stress.

The slides or guides, which steady and secure the cross-heads and connecting-rods, have also been fitted with the patent bearings, and the voyage to South America has been made without their being deteriorated by wear or attrition.

We consider the results of these applications of Mr. Babbitt's Patent to be highly satisfactory, and we think this invention will be found highly valuable in marine-engines. The method of lubrication by means of a mass of tallow pressed down by a spiral spring, is simple and efficient, and requires only common care to keep the bearings in working order.

The utility of block-tin, and of those alloys of which tin is the basis, in preventing attrition, has long been known to engineers; and its application in blocks or masses of tin, in place of those of brass or gun-metal, has frequently been attempted, but hitherto without success, from the difficulties that seemed to attend it, arising chiefly from its liability to yield to great stress, and to spread under heavy pressure.

These difficulties have been entirely overcome by Mr. Babbitt's ingenious method of fixing and retaining the alloy in a block of harder metal, and we conceive that his invention requires only to be better known to insure its general adoption in the bearings of marine-engines.

(Signed) JOHN FAREY.
JOSEPH GLYNN.

To Joseph Woods, Esq., London.

The Report of JOSEPH GLYNN, *F. R. S., M. Instr. C. E., and* BENJAMIN CUBITT, *C. E., and Locomotive Engineer on the Great Northern Railway, on the Soft Metal Bearings now used on the Locomotive Engines on the Great Western Railway.*

London, October 16, 1847.

SIR,—We beg leave to state the result of the observations and inquiries which we were enabled to make on the Great Western Railway when we visited the Company's locomotive engine establishment at Swindon, on the 13th instant.

Being permitted to examine the engines, especially those undergoing repair, we were afforded every facility we could desire by the engineers and agents of the Company, who frankly and courteously answered our questions relative to the use of the Patent soft Metal Bearings invented by Mr. Isaac Babbitt, of Boston, in the United States of America.

We learned they were first tried on the Great Western Railway in December, 1843; and the trial proving satisfactory, they have since been applied successively to the different engines on the line, until the whole of the Company's locomotive engines now at work, amounting in number to 145, have been so fitted.

The Patent soft Metal Bearings are used both in the straight and crank axles, and in the connecting-rods of all the engines, also in the coupling rods upon the wheels of those engines conveying the heavy goods' trains, in which the six wheels being of equal diameter, are all made to act as driving-wheels.

By means of an ingenious and accurate weighing-machine, the weight of each engine can be readily ascertained, and the machine shows at the same time the weight borne by each pair of wheels.

The great speed at which the passenger engines travel, and the comparatively small size of the bearings in proportion to the weight they carry, is a severe test of the capabil-

ity of the Patent Metal Bearings to resist heavy pressure at high velocities.

We particularly examined the Orion and the Dart, which are similar engines, and the Stentor, which resembles them in all respects, except the length of stroke, which is eighteen inches instead of twenty.

The Orion and Dart have each two cylinders of sixteen inches in diameter and twenty inches stroke; they have six wheels, the driving-wheels seven feet in diameter, the leading, or fore-wheels, are four feet, as are also the hind, or trailing-wheels.

The weight of these engines is twenty-three tons seventeen cwt., of which the driving-wheels bear ten tons, the leading wheels eight tons four cwt., and the trailing wheels five tons thirteen cwt.

The weight on the driving, or crank, axles is supported on four bearings; the two outer bearings being four inches in diameter, and seven inches and a half long; the two inner bearings six inches and three-quarters diameter and four inches long. The bearings of the leading axle are three inches and a half in diameter and six inches and three-quarters long, and of the hind wheels three inches and a half diameter, and six inches and three-quarters long.

The average rate of travelling by the afternoon express trains being about forty-five two-third miles (45·65) per hour, causes the driving-wheels of these engines, when so employed, to make 182 revolutions per minute, and the other wheels 318.

Under these circumstances, the soft metal bearings are found, with ordinary care, to be much more durable than gun-metal; they are not so liable to heat, and seldom do so, unless there be great neglect in the lubrication.

The appearance of the bearings was highly satisfactory, both the surfaces of them and the axles were highly polished, without any signs of abrasion.

We also examined the Avalanche, Cyclops, and Sylph, now also under repair, in which the appearances were precisely similar.

We next inspected the connecting-rods of these engines, especially those of the Dart, Orion, and Sylph; the single bearing at the larger end of these connecting-rods acting upon the crank is six inches and three-quarters in diameter, and five inches long, and the two bearings in the forked ends attached to the piston-rod are each two inches and a quarter diameter, and two inches and a quarter long. The weight of the Sylph is twenty-five tons. The cylinders are sixteen inches in diameter, their stroke twenty-four inches, the driving-wheels seven feet in diameter, and the steam is worked at a pressure of one hundred pounds to the square inch, equal, before its expansion, to a force of eight tons nineteen cwt. upon the piston in each of the two cylinders. The other engines were worked at seventy-five pounds on the square inch, giving a pressure of six tons fourteen cwt. in cylinders of like diameter.

In transmitting this force to the crank axles at so high a velocity as 182 revolutions per minute, the resistance and durability of soft metal bearings, having so small a surface, is severely tested, and is found superior to gun-metal, as being less liable to abrasion and heat, and consequently much more durable.

The connecting-rods which couple the wheels of the heavy goods' engines are fitted with Patent Bearings, also subject to great stress. One of these, named the Premier, had travelled 43,000 miles without injury to these bearings, which in gun-metal would probably not have run more than 8,000 or 10,000 miles without needing repair.

The Patent Metal Bearings are made by casting, or turning in the usual gun-metal blocks, a recess about an eighth of an inch in depth to be filled up with a lining of soft metal, retained in the cavity by solder, and prevented from yielding

and spreading out under the action and pressure of the engines by fillets of gun-metal, which are cast or formed upon the blocks for that purpose, and standing nearly as high as the soft metal, come almost in contact with the axle or crank to which the soft metal bearing is applied.

The two gun-metal blocks are then keyed up firmly and close together, so as to admit of no shake or play; a mode of fitting which appears essential to this kind of bearing, both in locomotive and marine engines.

As the Patent Metal Bearings consist of an alloy, of which tin forms the chief ingredient, the mixture at present being ninety-six parts of tin, four of copper, and eight of antimony, it probably melts at about 450 degrees of heat. In case of neglect on the part of the engine-drivers to supply the lubricators with oil before the commencement of the journey, or in permitting the oil holes to become choked up, it is sometimes impossible to remedy the omission afterwards. This happens occasionally, and in some instances the bearings have run so far without oil, that heat sufficient to fuse the metal has been produced.

We found that a case of this kind had occurred with the Bronte, a powerful goods' engine, which started at 4h. 30m. A. M. on Saturday the 9th instant, conveying a train of forty-two wagons, each averaging ten tons in weight. It appears that one of the larger ends of the connecting-rods had not been properly supplied with oil, so that abrasion and heat took place, and the metal melted. We had the bearing brought to us in the same state as it was found when taken out; most of the soft metal had been melted, but a portion of it still remained in the recess, and was in contact with the axle. The fillets of gun-metal having also taken a bearing on the axle, the engine was enabled to complete the journey and come to Swindon to have the block replaced, which was done that evening, and the engine took its station on the following morning.

The loss of the soft metal gave about three-sixteenths of an inch play on one crank, and caused a jerk to that extent in the piston of one cylinder at each turn of the crank.

It appears that the larger ends of the connecting-rods, where the rapidity of the motion and pressure are greatest, are most liable to this inconvenience, which, however, does not occasion more serious results than have been stated, and that it only happens through neglecting to fill the lubricators before starting, or from want of common care in keeping the oil-holes free.

The increased distance which the engines can run with these improved bearings, as compared with those of gun-metal, without requiring repair, effects considerable saving in locomotive power, and enables the same number of engines to perform a larger amount of work. The performance of the following engines, with the same bearings, was given out from the Company's books:—

The Dart ran, from the 30th of March, 1846, to the 6th of September, 1847,	30,536	miles.
The Cyclops, from the 13th of September, 1845, to the 7th of September, 1847, - - - - - -	43,468	"
The Orion, from the 29th of December, 1846, to the 9th of October, 1847,	25,011	"
The Sylph started on the 16th of March, 1847, and ran to the 3d of October, 1847, - - - - - -	17,304	"
The Hercules, from the 11th of July, 1846, to the 8th of October, 1847,	20,595	"

We think the application of the Patent Soft Metal Bearings has proved highly beneficial in the working of locomotive engines on the Great Western Railway, as tending to augment their tractive power by reducing the friction of the cranks and axles, and also by increasing the mileage, or distance run, without those bearings requiring adjustment or

repair; and we therefore consider ourselves warranted in recommending the use of this invention on other railways.

(Signed) JOSEPH GLYNN.
BENJAMIN CUBITT.

To JOSEPH WOODS, ESQ., London.

The Report of JOSEPH GLYNN, *F. R. S., M. Instr., C. E., on the Results of the Application of Babbitt's Patent Soft Metal Bearings to the Locomotive Engines on the Liverpool and Manchester Railway.*

London, December 24, 1847.

SIR,—The following Report is the result of my inspection of the Locomotive Engines on the Liverpool and Manchester Railway, in order to ascertain the effects produced by the application of Mr. Babbitt's Patent Bearings to the axles and other working parts of those engines.

I regret that the illness of Mr. Hick prevented him from undertaking or assisting in the investigation, as his experience and judgment would have been of great value in such an inquiry, which has thus unfortunately devolved on me alone.

The Liverpool and Manchester Railway is now amalgamated with the general system of railways called the London and North Western, but the local administration of the same officers who had the management of it as an integral and independent line, is still continued to a great extent, and the Locomotive Engine Department of the Liverpool and Manchester Branch remains under the care of Mr. Thomas Lunt and his assistants.

The Directors having permitted this inquiry to be made, and the Secretary having officially instructed these gentlemen not only to afford all needful facilities, and to answer such questions as might be asked respecting the working of

the Patent Bearings, but also to deliver to me such of them as I might think proper to take with me, I proceeded to Liverpool on the 6th instant, and on the following morning I examined several of the Locomotive Engines, both on the line of railway and in reserve at the sheds at Edge Hill, and others in the engine manufactory at that station then under repair.

The two assistants of Mr. Lunt, namely, Mr. Michael Allison, of the Liverpool end of the line, and Mr. Henry Lord, of the Manchester Terminus, who have been for several years in the Company's service, were also in attendance, to give such information as I might require, and I was also authorized to inspect the books, showing the performance and cost of working the engines on the Liverpool and Manchester Branch.

I found the number of engines belonging to this branch line to be fifty five, and with the exception of eight new engines recently made elsewhere, all of them are either wholly or in part fitted with the Patent Bearings, which will also be applied to the new engines as occasion requires; the Liverpool and Manchester Company, before the amalgamation of the railways, having taken a special license from the patentee for the use of the invention, which license still continues in force on this portion of the line, but does not at present extend beyond it.

The first of the engines so fitted was the *Heron*, a passenger engine on six wheels, with cylinders twelve inches in diameter and eighteen inch stroke, working with a pressure of steam of seventy-five or eighty pounds on the square inch, driving wheels of five feet in diameter, the leading wheels and following wheels being three feet six inches.

This engine, and others of the same class, having had increased work to do, the boilers had been lengthened twelve inches at the fore end, in order to give that additional length to the tubes, so as to produce more steam, and in conse-

quence of such alterations, an increased weight was thrown upon the axle of the fore or leading wheels, the bearings of which, three and a quarter inches in diameter and six inches long, were then of gun-metal.

The increased stress on these bearings caused them frequently to become heated by friction, and occasioned much trouble and inconvenience, so that in the month of August, 1843, when Mr. Babbitt proposed to the Company the use of his Patent Bearings it was resolved to make trial of them on this leading axle of the *Heron*, and in similar engines named the *King-fisher* and the *Ostrich*.

The gun-metal steps were then taken out, and a cavity was cut on each of them of about three-sixteenths of an inch in depth; the surface of the metal in this cavity was tinned, to cause adhesion of the soft metal or alloy of tin used by Mr. Babbitt, the axle was placed in the step, and the alloy being melted was poured into the recess thus formed between the axle and the gun-metal step, which together acted as a mould to receive the melted metal.

The steps so lined with the soft metal continued to run in the *Heron* upon this line of railway until the 30th of September, 1847, when the engine was taken into the works for general repairs, after having travelled with these steps a distance of 72,955 miles without their having heated, and without their requiring any repair during that period.

The diminution in thickness of the soft metal lining is not one-sixteenth of an inch, although it has become more dense and consolidated by constant stress, and by the rapid succession of blows or hammering action of the axle against the step, as the wheel is carried over the irregularities of the rails.

It appears that the former gun-metal steps required repair and adjustment after having run from 8,000 to 10,000 miles, and that they seldom lasted for more than 15,000 miles, or 20,000 miles at the utmost.

They were then entirely worn out, and had to be replaced with new steps; whereas the patent steps, after having run so great a distance, need only to be lined with soft metal as before to be again fit for use. The axles also show a high polish, and wear a much longer time.

The cavities in the original gun-metal steps having in this instance been cut with the chisel and file, the parts have been smoother, and the adhesion of the two metals less perfect, than if the recesses had been cast in the steps, as is now practised, consequently the soft metal is partially detached, and broken by the action before-mentioned, but not so as to prevent the further use of these steps, which might still continue to travel for some time to come.

I have brought these steps with me; they are marked 3 R and 3 L, being the right and left hand bearings of the leading axle of the *Heron*.

The weight or stress is entirely on the upper side of the axle and against these bearings; to the under side of the axle is applied a retaining cup or keep, made hollow, and containing a small supply of oil sufficient for the journey, which lubricates the axle by a sponge lightly compressed into the oil cup, or by means of a small lever carrying a broad cotton wick at one end, and counterbalanced at the other, so as to cause the wick immersed in the oil to press lightly against the axle.

The engines are lubricated in these axles, and all other working parts by oil only, and the usual daily consumption by each engine for that purpose is now only two pounds, or about one quart of rape oil, the engine making four trips per day, amounting in the aggregate to about 125 miles. The former rate of consumption of oil for lubrication previous to the introduction of the Patent Bearings, appears to have been about three times as much as it has been since their adoption.

The account of oil and tallow used for cleaning the engine is not kept separate from the oil used for lubrication, but the saving in the aggregate expenditure of oil and tallow, as appears from the Company's books, is fifty-nine per cent. I annex a statement showing the performance and consumption of oil by a number of engines, prior and subsequent to the use of the Patent Bearings.

It is to be observed that a pound of tallow is taken as a pint of oil, and that little tallow is used for any purpose.

I have mentioned that no tallow is used for lubrication, but in order to guard against neglect of the oiling apparatus, or omission in supplying it with oil, a reserve of tallow is kept above the steps of the axles communicating with the bearings by two holes drilled through the steps; so little friction, however, is produced even by the rapid motion of the axles against so small a surface of soft metal, that heat sufficient to melt the tallow is not evolved, whilst there is a supply of oil; and it often happens that the engine may run for many weeks without wasting the tallow, which is found entire when the engine is brought into the workshop to undergo general examination.

The fast trains make the trip between Liverpool and Manchester in one hour; but owing to the intervention of the Whiston incline, an ascending gradient of one in ninety-six, the speed on this line is equal to thirty-six miles an hour; so that the driving-wheels make 202 revolutions, and the leading wheels make 288 revolutions, per minute.

The weight of the passenger-engines in working order is about fourteen tons. The goods-engines have cylinders of thirteen inches diameter and twenty inches stroke, and weigh, in working order, about sixteen tons.

All the engines on the line, with the exception of the new ones lately received and not yet fitted with the Patent Bearings, have them applied to their axles and connecting-rods, and to other working parts in most of them; the chief stress

and wear being in the axles and the large ends of the connecting-rods which grasp the cranks.

The Liverpool and Manchester Railway Company having come to an agreement with the Patentee, in consequence of the satisfactory results of the trial of the Soft Metal Bearings in the leading axles of the *Heron*, and in the *King-fisher*, and the *Ostrich*, the application of them to the connecting-rods of the *Heron* took place in six weeks after their first introduction.

The bearings of the connecting-rods so fitted have ever since been in work, having run 68,900 miles, and are still in perfect order.

A pair of these bearings I have also brought with me; they are marked J. R. H.; the diameter of the crank on which they work is five inches and a quarter, and the length of bearing is four inches.

The Patent Bearings of the *King-fisher* were taken out for examination and kept as specimens, after having run a distance of 60,222 miles from the 18th of August, 1843, to the 4th of March, 1847, being then in excellent condition and not sensibly worn.

By way of experiment, gun-metal bearings were again tried, but they were found to heat and cut as they did before, and were soon replaced by the Soft Metal Bearings which are now at work.

When the bearings become slack, or the axles begin to play too much in the direction of their length, it is only necessary to melt out the alloy from the cavity of the gun-metal step to lay the axle into the step, and again to fill the space between them with melted soft metal, which thus compensates for the wear of the axle as well as for that of the step, no further fitting being needful; thus an engine may have a bearing made good when the day's work is done, and take its station again in the morning.

The *Heron* is now under general repair, but the original gun-metal steps will be again lined with the soft metal, and will be again used without requiring further repairs.

The advantages of being able to travel more than four times the distance with the same bearings, the high polish of the parts working in them decreasing the friction, and increasing the disposable power of the engines, the facility of repair when needful, and the reduction both of time and cost in doing it, are great and manifest; they have enabled the Company to meet an extended traffic without a corresponding extension of locomotive stock.

It would be difficult for me to give a monetary estimate of these advantages, although I fully appreciate their value, and it would be impossible to come to precise results without making a complete analysed abstract of the locomotive accounts both before and since the use of Patent Bearings.

But I may state that from the 25th of December, 1845, when a new system of book-keeping was adopted, to the 31st of May, 1847, to which date the books were posted, during a period of eighteeen months,

	£	s.	d.
The Heron had run 25,602 miles, and the repairs had cost in wages,	54	3	7
and in materials	34	9	9
TOTAL	£88	13	4
The King-fisher had run 22,298 miles, and the repairs cost, in wages	109	5	5
and in materials	44	5	0
TOTAL	£153	10	5

The cost of repair to the other engines was similar in amount. Those who are conversant with the subject will perceive that great economy has resulted from some extraordinary circumstances, and these are explained by the increased durability of the working parts of the engines, which are still in good order.

I find from the engine manufactory books that up to the 30th of September, 1847, when the *Heron* was brought into the factory for repair of boiler and general examination, the further cost of repair was only 3*l.* 7*s.* 10*d.*, making the total cost of repair for two years only 92*l.* 1*s.* 2*d.*, during which time she had run 35,343 miles.

I should also mention that the Patent Bearings are now used to the shafts and machinery of the factory with great benefit.

I therefore feel myself warranted in stating that I am satisfied Mr. Babbitt's invention has been of much value in the present instance, and that it will be found highly beneficial to the proprietors of machinery generally, but more especially to railway companies and to the owners of steamships, the observations of Mr. Farey and myself on the engines on board of Her Majesty's steam-vessels being fully confirmed by the opportunity I have now had of witnessing the application of it on the Liverpool and Manchester Railway.

I am, Sir, your obedient servant,

JOSEPH GLYNN.

To Joseph Woods, Esq.

LIVERPOOL AND MANCHESTER RAILWAY — LOCOMOTIVE DEPARTMENT.

Statement showing the Number of Miles run and Quantity of Oil used by Locomotive Engines, prior and subsequent to the Application of Babbitt's Patent Metal Steps, commencing January 1st, 1843, and ending October 25th, 1844.

	Prior to using Babbitt's Patent.		*Subsequent to using Patent.*	
Engines.	Miles run.	Qts. Oil.	Miles run.	Qts. Oil.
Ostrich	7,290	212	21,630	150½
King-fisher	14,000	266½	11,515	175
Heron	14,640	284	12,280	114½
Crane	13,020	290	13,020	115
Swan	16,185	282½	12,821	115½
Stork	14,145	342½	14,475	99½
Pelican	13,600	326½	7,770	63
Cygnet	16,695	412½	4,417	45
Partridge	15,900	344½	3,345	29
TOTAL	125,475	2767	98,273	907

Average 1 mile=.0441 pints. Average 1 mile=.0184 pints.

$$\frac{.0184 \times 100}{.0441} = \frac{100}{41}$$

59 per cent.

ISAAC BABBITT would take this occasion to inform his friends and the public, that having relinquished to Mr. WILLIAM A. PIERPONT, his interest in the Brass Foundry and Machine Shop, (Corner of Blake's Court and Harrison Avenue, Boston,) all who wish to obtain his Patent Boxes or any kind of composition, or brass castings, can be furnished with them there, of superior quality and at reasonable prices.

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